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SCREENING OF PEA GERMPLASM AGAINST POWDERY MILDEW OF PEA (*Erysiphe pisi*) AND ITS MANAGEMENT THROUGH CHEMICALS

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Pea *(Pisum sativum)* is an important winter leguminous crop that is grown all over the world. Worldwide this crop is cultivated on an area of 528.71 thousand hectares and annual production is 10.6 million tons. Powdery mildew of pea (*Erysiphe pisi*) is fungus that attacks pea crop and causes 25% yield losses on the average. Present study was conducted to find out the source of pea against Powdery mildew of pea and efficacy of fungicides against the incidence of this disease. Fifteen pea varieties/lines were sown and data related to powdery mildew was recorded. Varieties/lines 2001-20, Peas 2009, 026721, F-16, No. 267, 2001-40 and Rondo were found resistant with mean disease severity of 6.2%, 1.49%, 6%, 2.28%, 5.48%, 1.61%, and 6.60% respectively. Meteor, Climax and PF-45 were susceptible with mean disease severity of 62.3%, 62.8% and 53.8% respectively, other varieties showed moderate results. Among five fungicides, Score gave best results in suppressing the disease and increased the horticultural parameters of the crop significantly followed by Baytan foilar, Mancozeb, Aliette and Sulfex gold.
Keywords: Pea *(Pisum sativum),* Powdery mildew of pea (*Erysiphe pisi*), Screening, Management.

INTRODUCTION

Pea *(Pisum sativum)* is an important winter leguminous crop that is grown all over the world due to its nutritional importance. It belongs to family leguminoseae (Nawab *et al*., 2008). Worldwide this crop is cultivated on an area of 528.71 thousand hectares and annual production is 10.6 million tons (FAO, 2011). In Pakistan it is grown on an area of 82.8 thousand hectare and annual production is 57.0 thousand tons (GOP 2011). Optimum temperature for proper growth and development of this crop is 16 to 18 ◦C (Hussain *et al*., 2002). A good amount of proteins, starches and carbohydrates are present in pea used in human nutrition. Pea contains starch (48%), carbohydrates (26%), protein (20-30%), phosphorus (2.95%), iron (0.035%), potassium (10.10%), magnesium (1.16%), zinc (0.024%), with traces of sugars and vitamin B9 (Ali *et al*., 2002; Azmat *et al*., 2011; FAO, 2016). During favorable conditions this crop is infected by many fungal, viral and bacterial diseases. Among these diseases, powdery mildew disease of pea is the most important and destructive one that is caused by a fungus *Erysiphe pisi* (Kraft and Pfleger, 2001). This disease occurs in January-February when plants are at their mature stage (Nisar *et al*., 2008). General yield losses due to this disease are 25-50% depending upon the severity of disease and favorable environmental conditions (Fondevilla *et al.*, 2012). Specific yield losses due to this disease are, decrease in pods number (21-31%) and decrease in pods weight (24-27%) (Nisar *et al*., 2006). This disease is more prevalent in late planted and late maturing pea crops. When the days are warm and nights are cooled, this disease appears in epidemic form (Kazmi *et al*., 2002). *Erysiphe pisi* is an air borne, obligate, bio trophic fungus which belongs to ascomycetes group (Falloon and Viljanen, 2001). This disease affects the all vegetative parts of the plant except roots. The symptoms of this disease are the production of white talcum like spots on the upper surface of the leaf. These spots are just like powdery mass and first appear on the lower surface of the leaves then move to the upper surface that can cover the whole plant in sever form. Disease progress well at temperature 17-25ºC. As the disease progresses, these spots increase in size, combines to one each other and may cover the whole surface of the plant (Schwarts *et al*., 2005). Optimum temperature, wind and humidity in weather favors the spread of the disease. Use of resistant cultivars/varieties is the best way for the management of powdery mildew disease of the pea. Use of resistant cultivars/varieties for the management of this disease increases the quality and yield of the crop. It also reduce the use of synthetic fungicides that is economical (Azmat *et al*., 2011). But in the absence of resistant source there is need to use certain available fungicides and other techniques for the management of this disease to reduce the chances of disease severity and improve the yield of crop (Sharma, 2006). Keeping in view the above facts, present study was conducted to check the reaction of pea germplasm against *Erysiphe pisi*. In addition evaluation

of different fungicides for the management of powdery mildew of pea was also be done.

MATERIALS AND METHODS

***Response of pea cultivars/varieties against Erysiphe pisi*:** Fifteen pea varieties/lines were sown for screening against *Erysiphe pisi* under field conditions. Screening nursery was established at the experimental area of department of Plant Pathology, University of Agriculture, Faisalabad. Nursery was sown on beds with (P x P) and (R x R) distance of 30 cm and 60 cm respectively under natural environmental conditions. Each variety/line was replicated thrice to get maximum results in Randomized Complete Block Design (RCBD). "Meteor" that was highly susceptible was used as spreader (Hussain *et al*., 2002). All agronomic practices were carried out properly. Data was recorded on weekly basis and mean of each month was calculated. To check the effect of powdery mildew on horticultural parameters of crop, number of leaves per plant, number of branches per plant, number of pods, number of seeds per pod, plant height and grain yield were measured.

***Response of different fungicides against powdery mildew of pea*:** Efficacy of five fungicides (Score 250 EC, Baytan foilar, Mancozeb, Aliette and Sulfex gold) was evaluated against powdery mildew disease of pea under natural field conditions on highly susceptible variety "Climax". Seeds of Climax were planted on beds with 30 cm plant to plant and 60 cm row to row distance. Each treatment was replicated thrice to get maximum results under Randomized Complete Block Design (RCBD). The sowing was done on 28th of the October 2015. All agronomic practices were applied to grow healthy and good crop. Three foliar sprays of recommended fungicides (Score 250 EC, Baytan foilar, Mancozeb, Aliette and Sulfex gold) were applied as a curative management after one month of crop germination and were repeated at 30 days intervals. Data related to disease severity were recorded at seven days intervals.

***Statistical analysis*:** Data were analyzed by using SPSS statistical analysis software package and Duncan's multiple range test was used for comparing the means (Steel *et al*., 1997).

RESULTS

***Evaluation of pea lines/varieties against powdery mildew of pea*:** After sixty days of crop sowing, percent disease severity data were recorded three times after 60, 90 and 120 days intervals. Disease data recorded during different stages of crop is shown in table 1. The percent disease severity was lower after 120 days as compared to the 90 days but higher than 60 days. The advance varieties/lines Meteor (62.3%), Climax (62.8%) and PF-45 (53.8%) showed the maximum percent disease severity and were highly susceptible. In case of varieties/lines Green Grass (44%), VIP (36.5%), Azad (34.8%) and Peas Meto (28.3%) percent disease was moderate these were categorized as moderately susceptible. Minimum percent disease severity was observed in case of varieties/lines 2001-20 (6.2%), Peas 2009 (1.49%), 026721 (6%), F-16 (2.28%), No. 267 (5.48%), 2001-40 (1.61%) and Rondo (6.60%) so these were categorized as resistant varieties. One variety Winner (22.2%) was moderately resistant as it showed resistant to some extant against powdery mildew disease.

Table 1. Percent disease severity of powdery mildew of pea disease on different varieties/lines after 60, 90 and 120 days.

Varieties /lines	Percent disease severity			Disease severity %
	After 60 days	After 90 days	After 120 days	
Meteor	42.20	79.80	65.00	62.30
Climax	43.70	78.20	66.10	62.80
PF-45	41.63	69.33	50.47	53.80
Green Grass	31.09	59.11	41.90	44.00
VIP	23.30	42.20	44.08	36.50
Azad	21.80	42.40	40.10	34.80
Peas Meto	17.30	34.70	32.90	28.30
Winner	14.70	27.10	24.90	22.20
2001-20	2.10	8.89	6.80	6.20
Peas2009	0.70	1.50	2.30	1.49
026721	2.60	8.60	6.80	6.00
F-16	1.30	3.00	2.60	2.28
No.267	2.30	7.80	6.40	5.48
2001-40	1.00	1.70	2.10	1.61
Rondo	2.40	9.00	8.40	6.60

***In vivo evaluation of different fungicides against Erysiphe pisi*:** The efficacy of different fungicides viz., Score 250 EC, Baytan foilar, Mancozeb, Aliette and Sulfex gold was evaluated against powdery mildew of pea. For this purpose, highly susceptible variety Cluimax was sown. Three sprays of chemicals with recommended doses were done under field conditions and data were recorded after 15 days of each spray. Disease incidence was less after the application of these fungicides. Disease incidence varied among five fungicides. Disease incidence was maximum in case of Sulfex gold that showed (30.39%) as compared to the Score 250 EC, Baytan foilar, Mancozeb and Aliette. In case of Score 250 EC disease incidence was (14.23%) followed by Baytan foliar (17.33%), Mancozeb (24.41%), Aliette (28.28%) and Sulfex gold (30.39%) as compared to the control (68.69%). Treatments and sprays (TxS) interaction showed that in all treatments, the disease incidence was minimum after third spray. Minimum disease reduction was shown in three concentrations in case of Sulfex gold (30.39%) as compared to the Aliette (28.28%), Mancozeb (24.41%), Baytan foliar (17.33%) and Score 250

EC (14.23%) as shown in Table 2 & 3. Fig. 1 clearly showed the interaction between treatments and sprays (TxS) against powdery mildew of pea disease.

Table 2. Impact of different chemicals treatments against powdery mildew of pea

Treatments	Disease incidence
Score 250 EC	(14.26%)
Baytan foliar	(17.33%)
Mancozeb	(24.41%)
Aliette	(28.28%)
Sulfex gold	(30.39%)
Control	(68.69%)

Table 3. Impact of different chemicals interactions between sprays and treatments against powdery mildew of

Treatments	Disease incidence		
	1st spray	2nd spray	3rd spray
Score 250 EC	19.32	14.36	09.11
Baytan foliar	22.32	17.33	12.34
Mancozeb	29.31	24.32	19.32
Aliette	33.33	28.28	23.34
Sulfex gold	35.36	30.68	25.32
Control	70.78	69.36	65.95

Different plant growth parameters like number of leaves per plant, number of flowers per plant, plant height, pod length, number of grains per ten pods, weight of grains per ten pods, weight of peel per ten pods and grain yield were measured. For all varieties/lines these parameters are given in Table 4. These all parameters were statistically significant. Maximum yield was recorded in case of Peas 2009 and minimum yield was recorded in case of Meteor.

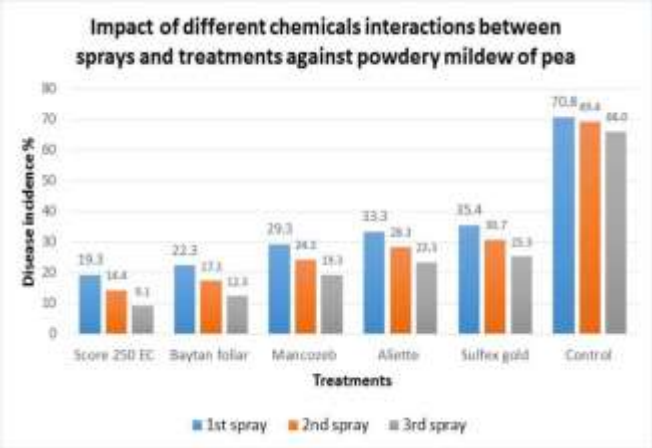

Figure 1. Effect of powdery mildew disease on growth parameters of pea plant:

DISCUSSION

Pea *(Pisum sativum)* is an important vegetable crop which is native to the Asia and belongs to family leguminoseae (Nawab *et al*., 2008). Pea crop is affected by many pests, insects and diseases. Among them powdery mildew is most destructive one that causes heavy losses worldwide (Kraft and Pfleger, 2001). During Jan-Feb this disease appears as white powdery mass of fungus on lower and upper sides of the leaves and covers the whole plant as disease progresses

Table 4. Effect of powdery mildew fungus on horticultural parameters of pea crop.

Varieties/ lines	No. of Leaves /plant	No. of Flowers /plant	Plant height (cm)	Pod length (cm)	No.of Grains/ pod	Weight of peels/ 10 pods	Weight of grains/ 10 pods
Meteor	33.02	17.02	49.64	5.77	5.65	6.33	4.25
Climax	36.20	17.82	50.02	6.11	5.83	6.18	4.59
PF-45	38.19	19.15	50.41	6.43	6.02	6.42	4.93
Green Grass	34.45	18.29	53.43	6.06	5.92	5.91	4.78
VIP	35.11	18.65	53.56	5.96	5.81	5.57	6.11
Azad	33.33	17.72	51.45	6.91	6.90	6.79	6.00
Peas Meto	34.17	17.63	54.43	6.67	6.59	7.84	5.93
Winner	33.51	18.25	52.21	5.87	5.31	5.64	5.97
2001-20 Peas 2009	37.63	19.03	55.92	7.13	7.00	6.80	6.14
026721	43.22	22.33	58.71	6.95	6.85	6.67	6.89
F-16	34.45	19.21	53.44	5.43	5.45	5.71	5.70
No. 267	40.39	19.95	55.73	7.06	6.81	6.73	6.72
2001-40	39.98	19.98	55.37	7.19	7.11	6.93	6.97
Rondo	42.21	21.93	57.23	6.97	6.89	6.83	6.82
	41.89	20.93	58.12	7.11	7.03	7.96	6.56
LSD values							

ultimately the plant becomes pale brownish. Severity of disease and losses depend upon the environmental conditions and vary among these conditions (Sinha *et al*., 2002). For the management of this disease use of resistant advance lines/varieties is most important. Screening of available germplasm is most important method to find out the resistant source (Jan *et al*., 2007). For this purpose, different efforts are made every year. In this study disease severity data is statistically significant, maximum disease severity was found in case of Meteor (62.3%), Climax (62.8%), PF-45 (53.8%) and Green Grass (44%). Moderate resistance or resistance to some extant was shown in case of VIP (36.5%), Azad (34.8%), Peas Meto (28.3%) and Winner (22.2%). The advance lines which showed fully resistant were; Peas 2009 (1.49%), 2001-40 (1.61%), 2001-20 (6.2%), 026721 (6%), F-16 (2.28%), No. 267 (5.48%) and Rondo (6.60%). In a study conducted by (Rehman *et al*., 2014) it was found that Meteor and PF-45 were highly susceptible varieties. (Hussain *et al*., 2001) in his study found that cultivars Meteor and Climax were highly susceptible against powdery mildew of pea disease. (Amna, 2014) reported that Peas 2009 and F-16 were high yielding cultivars, whereas Meteor and PF-45 were low yielding cultivars of pea. It was found that temperature 26 ºC favors the development and spread of this disease and causes 25-50% yield losses (Fondevilla *et al.*, 2012). In late sowing and late maturing pea crops the incidence of powdery mildew disease is more and yield losses reached up to 50% (Rehman *et al*., 2014). When resistant source is not available then different strategies are used for the management of this disease. Among them, use of chemicals (fungicides) is the best and quick method. Use of chemicals inhibit the attack of *Erysiphe pisi* fungus, enhance the normal metabolic and physiological functions of plant, so healthy crop and more yield is obtained. In this experiment Score showed the best results against powdery mildew of pea followed by Baytan foilar, Mancozeb, Aliette and Sulfex gold as shown in table 2. These results were supported by the study of (Yousaf *et al*., 2016). Different studies conducted by different scientists showed that Dinocarp, Carbendazine and Tidemorph were effective for the management powdery mildew of pea under field conditions.

***Conclusion*:** Among different varities/lines, Peas 2009, F-16 and 2001-40 were found resistant and showed minimum disease severity (1.49%), (2.28%) and (1.61%) respectively and gave the best yield. Similarly Score 250 EC gave the best results for the control of *Erysiphe pisi* and can be used commercially for the same purpose under field conditions.

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